

CLAIMS

1. Cooling equipment, especially for the cryopreservation of biological samples (15'), with
 - a cooling agent supply line (5, 5') for supplying a cooling agent (3, 3') to a cooling chamber (1, 1'),
 - a heater (6, 6') with an adjustable first heating performance (P2) for heating the cooling agent (3, 3') supplied to the cooling chamber (1, 1'),
 - a first temperature sensor (8-10, 8', 9', 17' 19') for measuring the temperature (T2-T4, T2', T3') in the cooling chamber (1, 1'),
 - a second temperature sensor (7, 7') for measuring the temperature (T1, T1') of the cooling agent (3, 3') supplied to the cooling chamber (1, 1'),
 - a controller (11, 11') for temperature control,

characterized in that

the controller (11, 11') is a multiple controller that detects several temperatures (T1-T4, T1'-T3') as control variables and/or adjusts several heating performances (P1, P1', P2, P2') as manipulated variables.
2. The cooling equipment according to Claim 1, **characterized in that** the cooling agent supply line (5, 5') is connected to a cooling agent storage container (2, 2') in which the cooling agent (3, 3') is located.
3. The cooling equipment according to Claim 2, **characterized by** an evaporator (4, 4') with an adjustable second heating performance (P1, P1') for evaporating the cooling agent (3, 3') present in the cooling agent storage container (2, 2').
4. The cooling equipment according to Claim 3, **characterized in that** the multiple controller (11, 11') is connected on the input side to the first temperature sensor (8-10, 8', 9', 17', 19') and to the second temperature sensor (7, 7') and on the output side to the heater (6, 6') and to the evaporator (4, 4').
5. The cooling equipment according to any one of the preceding claims, **characterized in that** several temperature sensors (8-10, 8', 9', 17', 19') connected to the multiple controller (11) are provided for measuring the temperature in the cooling chamber (1, 1').

6. The cooling equipment according to Claim 5, **characterized in that** the temperature sensors (8-10, 8', 9', 17', 19') are arranged in a spatially distributed manner for measuring the spatial distribution of temperature.
7. The cooling equipment according to Claim 5 or 6, **characterized in that** at least one of the temperature sensors (8-10, 8', 9', 17', 19') is a thermocouple and at least one of the temperature sensors (8-10, 8', 9', 17', 19') is a temperature-dependent electrical resistor.
8. The cooling equipment according to any one of the preceding claims, **characterized in that** the heater (6, 6') is integrated in the cooling agent supply line (5, 5').
9. The cooling equipment according to any one of the preceding claims, **characterized in that** the cooling agent (3, 3') is nitrogen.
10. The cooling equipment according to any one of the preceding claims, **characterized in that** the first temperature sensor (8-10, 8', 9', 17', 19') and/or the second temperature sensor (7, 7') is/are connected to a storage equipment (12, 12') that stores the temperature courses.
11. The cooling equipment according to any one of the preceding claims, **characterized in that** the cooling agent supply line (5, 5') empties via a diffuser (14, 14') into the cooling chamber (1, 1').
12. The cooling equipment according to any one of the preceding claims, **characterized in that** the cooling agent supply line (5) empties laterally into the cooling chamber (1).
13. The cooling equipment according to Claim 12, **characterized in that** the cooling agent supply line (5) empties into the cooling chamber (1) only on one side of the cooling chamber (1).
14. The cooling equipment according to any one of the preceding claims, **characterized in that** the cooling agent supply line (5') empties into the cooling chamber (1') at the top of the cooling chamber (1').

15. The cooling equipment according to any one of the preceding claims, **characterized in that** the cooling chamber (1) is closed
16. The cooling equipment according to any one of the preceding claims, **characterized in that** the cooling chamber (1') is open on its bottom.
17. The cooling equipment according to any one of the preceding claims, **characterized in that** the cooling chamber (1 ') is portable.
18. The cooling equipment according to any one of the preceding claims, **characterized in that** the first temperature sensor (17') is arranged inside the cooling chamber (1') and at an interval from its wall.
19. The cooling equipment according to Claim 18, **characterized in that** the first temperature sensor (17') is fastened to the cooling chamber (1') by a holding equipment (18') extending into the cooling chamber (1').
20. The cooling equipment according to Claim 18, **characterized in that** the first temperature sensor (19') is attached to the sample (15') or to a sample holder.
21. The cooling equipment according to any one of the preceding claims, **characterized in that** the first temperature sensor (19') is connected to a transponder that transmits the measured temperature in a wireless manner to the control device (11').
22. The cooling equipment according to Claim 21, **characterized in that** the transponder is a radio transponder, ultrasonic transponder, optical transponder or an infrared transponder.
23. An operating method for a cooling equipment, especially for the cryopreservation of biological samples (15'), with the following steps:
 - introduction of a cooling agent (3, 3') into a cooling chamber (1, 1') for cooling cooled material,
 - heating the cooling agent (3, 3') prior to the introduction into the cooling chamber (1, 1') with an adjustable first heating performance (P2),
 - measuring of the temperature (T1, T1') of the heated cooling agent (3, 3'),
 - measuring of the temperature (T2-T4, T2', T3') in the cooling chamber (1, 1'),

- controlling the temperature,

characterized in that

a multiple controlling takes place in that both temperatures (T1-T4, T2', T3') are detected as control variables and/or in that a further manipulated variable (P1, P1') is adjusted in addition to the first heating performance (P2, P2').

24. The operating method according to Claim 23, **characterized by** the following steps:
 - evaporation of the liquid cooling agent (3, 3') in a cooling agent storage container (2, 2') with an adjustable second heating performance (P1, P1'),
 - heating of the evaporated cooling agent (3, 3') prior to its introduction into the cooling chamber (1, 1') with the adjustable first heating performance (P2, P2'),
 - multiple controlling of the first heating performance (P2) and of the second heating performance (P1, P1').
25. The operating method according to Claim 23 or 24, **characterized by** the following steps:
 - measuring of several spatially distributed temperatures (T2-T4, T2', T3') inside the cooling chamber (1, 1'),
 - multiple controlling of the first heating performance (P2, P2') and/or of the second heating performance (P1, P1') as a function of the different temperatures (T2-T4, T2', T3') inside the cooling chamber (1, 1').
26. The operating method according to any one of Claims 23 to 25, **characterized by** the following steps:
 - measuring of the temperature (T2-T4, T2', T3') in the cooling chamber (1, 1') and/or of the temperature (T1, T1') of the cooling agent (3, 3') prior to its introduction into the cooling chamber (1, 1') with a thermocouple,
 - measuring of the temperature (T2-T4, T2', T3') in the cooling chamber (1, 1') and/or of the temperature (T1, T1') of the cooling agent (3, 3') prior to its introduction into the cooling chamber (1, 1') with a temperature-dependent resistor,
 - multiple controlling of the first heating performance (P2, P2') and/or of the second heating performance (P1, P1') as a function of the temperature

measured by the thermocouple and of the temperature measured by the temperature-dependent resistor.

27. The operating method according to any one of Claims 23 to 26, **characterized** by the following steps:
- setting of a target value (T_{TARGET}) in the cooling chamber (1, 1'),
 - controlling the temperature ($T1, T1'$) of the cooling agent (3, 3') entering into the cooling chamber (1, 1') in accordance with the target value (T_{TARGET}) set for the cooling chamber (1, 1') by an adjusting of the first heating performance ($P2, P2'$).
28. The operating method according to Claim 27, **characterized in that** the temperature ($T1, T1'$) of the cooling agent (3, 3') entering into the cooling chamber (1, 1') is controlled to the target value (T_{TARGET}) for the temperature in the cooling chamber (1, 1').
29. The use of a cooling equipment according to any one of Claims 1 to 22 for the cryopreservation of biological samples (15').
